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# Pediatric Lyme Disease Prevention

Tracey A. Mannion  
*UMASS Amherst*

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Pediatric Lyme disease Prevention

Tracey Mannion

University of Massachusetts, Amherst

Capstone Project

Approved as to style and content by:

Chair, Karen Kalmakis, PhD, MPH, RN, FNP-BC

Member, Emma Dundon, PhD, RN, CPNP

Mentor, Deirdre Arvidson, BSN, RN

Abstract

Diagnoses of Lyme disease (LD) in Massachusetts have been on the rise in recent years, with one of the highest incidence rates in young school-age children. LD diagnoses may impact the short and long term health of children, as well as their economic, educational, and social well-being. Review of the literature indicates that educational interventions on LD have effectively increased preventative knowledge of LD in children and their parents. These educational interventions include instruction regarding protective practices such as tick checks, wearing protective clothing, and use of repellants, as well as tick ecology education. The purpose of the educational intervention described in this paper, was to prevent infection of LD by increasing knowledge of the disease, including preventive measures, among young children and their parents. The educational intervention involved teaching LD prevention to children in the classroom, and teaching parents through educational packets. The LD program was evaluated using a pre-test post-test program evaluation design. The theoretical framework chosen to support this educational intervention was the Health Belief Model. Results of the program were that the educational intervention for children regarding tick ecology and protective practices, increased preventative knowledge of LD in children as young as five.

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## **Introduction**

Diagnoses of Lyme disease (LD) in Massachusetts have been on the rise in recent years. The Massachusetts Department of Public Health (MDPH) (2014) confirmed 3,342 cases in 2012, and reported 1,708 probable cases in 2012. This was an increase from the confirmed number of cases of 2,651 in Massachusetts for the year 2011. Reported incidence rates of Lyme disease in 2012 were also higher for most counties, compared with 2011. One of the highest incidence rates in 2012 was among children ages five to nine years old. Lyme disease (LD) is a bacterial infection caused by the spirochete *Borrelia burgdorferi*, which is transmitted to humans by a tick bite, and was first identified in 1975 in Lyme, Connecticut. (Massachusetts General Hospital, 2013). LD has emerged in great force over the past fifty years due to reforestation after the abandonment of pastures and farms, increased development and recreational use of habitat, and expansion in the density of white tailed deer who are the reproductive host (Commonwealth of Massachusetts, 2013).

Millions of dollars are lost in employee absences due to Lyme disease, hundreds of schoolchildren miss school, and millions of dollars are spent on LD treatment (MDPH, 2011). Symptoms of LD may include a minor rash, to more serious symptoms such as poor motor coordination, hepatitis, cardiac and psychological problems (Massachusetts General Hospital, 2013).

The purpose of the educational intervention described in this paper, was to prevent infection of LD by increasing knowledge of the disease, including preventive measures, among young children and their parents.

### **Review of Literature**

In preparation to design an intervention to target LD, a systematic review of the literature was conducted using Preferred Reporting Items for Systematic reviews and Meta-Analyses

(PRISMA). The literature search was started in the PubMed database, as PubMed contains scientific literature from highly regarded peer-reviewed journals. As the interest was in LD prevention measures for children, the search phrase “Lyme disease and pediatric” was used, which evidenced 307 literature reports. Also used was the search phrase “prevention of Lyme in children”, which evidenced 157 articles. Cumulative Index to Nursing and Allied Health Literature (CINAHL) was searched using the terms “Lyme disease” and “pediatric”, which evidenced 34 literature reports, and “Lyme disease”, “pediatric” and “prevention” which evidenced seven titles, with only three fully related to LD. Using the terms “Lyme disease”, “pediatric”, and “education”, evidenced nine titles, six specific to LD, one of which was in Slovene.

After scanning titles, abstracts were read to determine if the literature report was related to the chosen topic. Articles focusing on other tick-borne diseases, such as babesiosis, or on Lyme as a co-morbidity to another disease state (such as rheumatic fever) were excluded. Also excluded from the review were articles relating to vaccines, which included LD vaccines. However, LD vaccine information was cited and discussed in the historical perspective of this review. An additional research website “Insightmeme”, a collection of scientific conference posters was utilized. A search of this database using “Lyme disease and pediatric”, produced 32 scientific posters, two of which were chosen to file for future research, and not used for this project. Ten papers were chosen to review, one practice guideline, three randomized clinical trials, three cross-sectional studies, one observational study, and two anecdotal papers based on professional experience and peer-reviewed literature reports. Studies ranged in date from 2001 to 2014, one report was from Canada, one from the Netherlands, and the additional eight were from the United States. It should be noted that although there were literature reports regarding LD

education, the number of LD literature reports regarding LD education and the pediatric population are limited.

### **Tick Ecology and Personal Protective Practices**

Education regarding tick ecology, and personal protective practices such as tick checks, and wearing protective clothing and applying repellent, are commonly discussed in LD prevention literature as ways to decrease the risk of LD infection (Beaujean et al., 2013; Daltroy, 2007; Hamlen & Kilman, 2009; Hayes & Piesman, 2003; Nelder et al., 2014; Wormser et al., 2006).

Each spring, the risk of infection increases when deer ticks become active, and personal outdoor activities increase (Hamlen & Kilman, 2009). As such, education regarding the ecology of the tick, demographic and geographic information including the tick's habitat, and physical characteristics of the tick, have been shown to be helpful in LD avoidance and prevention (Beaujean et al., 2013; Daltroy et al., 2007; Hayes & Piesman, 2003; Nelder et al., 2014; Phillips et al. 2001). As stated by in the practice guidelines by the IDSA (Wormser et al., 2006), and supported by the literature, the best currently available method for preventing infection with *B. burgdorferi* and other *Ixodes*-transmitted infections is to avoidance of tick-infested areas, which must also be taught to children to enhance pre-cautionary behavior (Phillips et al. 2001; Wormser et al., 2006). Ecological education should also include information that ticks live on the ground in woods and tall grasses, and not up in trees, the size of the tick and what they look like, that headgear does not provide protection, and main bite sites on the body (Daltroy, 2007).

### **Tick Checks**

Bodily tick checks, and proper removal of the ticks, have been discussed throughout LD prevention literature as one of the most efficacious type of personal behavioral protective

practices that can be completed by children and their parents (Beaujean et al., 2013; Daltroy et al., 2007; Hayes & Piesman, 2003; Nelder et al., 2014; Wormser, 2006). Tick check and proper removal behaviors can be effective at preventing LD infection, as ticks must feed for a minimum of 24 hours before the infection can be transmitted to the host (Beaujean et al., 2013).

Nelder (2014) collected over 14,000 publically submitted ticks. The higher incidence of ticks in the age group of children ages 0 to 9 years-old, indicates an opportunity for education programs on tick checks in this age group (Nelder et al., 2014). It should be noted that children who have known a person who became ill after tick-bite, were associated with a good perceived severity and LD knowledge score (Beaujean et al., 2013). Beaujean et al. (2013) suggests it is useful to focus on educating children about ticks and tick-borne diseases. Although parents generally perform body checks on their children, the knowledge, perceived susceptibility and importance of protective behaviors among the children, is directly related to the desired behavior modeled by the parents performing the body checks (Beaujean et al., 2013). The results of a meta-analysis indicate frequent visual inspection of skin and clothes may prevent tick attachment (Wormser et al., 2006). Modeling tick check behavior, such as on a fake arm, provides another opportunity to practice tick search and removal behaviors and raise self-efficacy for tick search and removal behaviors (Daltroy, 2007).

Furthermore, research by Heller (2010), with a Brazilian population residing in Martha's Vineyard, stressed the importance of tick check education being performed in a person/child's native language (Heller, 2008).

LD is preventable by not only early removal of the tick, but also proper removal of the tick (Daltroy et al., 2007; Wormser et al., 2006). Attached ticks should be removed promptly, using fine-tip forceps (Wormser et al., 2006). If the tick is crushed during removal, the tick's

infected body fluids with infectious spirochetes may enter the person, raising the risk of LD infection.

### **Protective Clothing and Tick Repellant**

Educational interventions for use of protective clothing and tick repellant have also been discussed throughout LD prevention literature as efficacious at preventing LD (Vasquez et al. 2008; Wormser et al., 2006).

Vasquez et al. (2008) conducted a case control study to assess the effectiveness of personal preventative measures in a highly disease-endemic area. The populations of 709 case patients, who had been previously diagnosed with LD, and 1,128 matched controls who had not been diagnosed with LD, between the ages of 15 and 70 years old, were interviewed about protective measures. The research recommended that personal protective measures, e.g. wearing long sleeve shirts and pants, were 40% effective at reducing LD, and tick repellents were 20% effective. Indeed, after a simple educational intervention for LD, subjects in the education program adopted increased precautionary behavior, compared to the control group (Daltroy, 2007).

The International Disease Society of America (IDSA) practice guideline, compiling evidence of over 400 studies, confirmed that the use of protective clothing, and repellants with diethyltoluamide (DEET), may prevent tick attachment (Wormser et al., 2006). The researchers found that the use of protective clothing (long-sleeved shirt tucked into pants and long pants tucked into socks), may interfere with tick attachment, increasing the time required for ticks to find exposed skin, and facilitating their recognition and removal. Wearing light-colored clothing to provide a background that contrasts with the tick is often recommended as a common sense

precaution to enhance the ability to see and remove ticks before attachment (Wormser et al., 2006).

According to the Commonwealth of Massachusetts (2013), education should include tick identification resources, tick reduction and avoidance strategies, and tick-bite management strategies, all of which were included in the packet. Additional scientific articles indicate educational intervention regarding tick checks, wearing protective clothing, and use of repellants, decrease the risk of LD infection (Beaujean et al., 2013; Hayes & Piesman, 2003; ISDA, 2013; Malouin et al., 2003; Vasquez et al., 2008). These preventative measures are cost effective, convenient, and not extremely time consuming. Therefore, any perceived barriers to prevention practices should be lessened, especially if the population understands the perceived benefits of completing the preventative interventions. There should also be education provided regarding recognition of symptoms (Heller et al., 2010). Prevention measures recommended by the state of MA, which were listed on the parent side section of the packet, included environmental modes of intervention (deer culling, deer fencing, and insecticides) (COM, 2013). COM (2013) recommends the messages be “simple” so they are easy to read and understand. Heller (2010), indicates there may be a need to translate educational interventions into another language, however, 89 % of this specific town population speaks English, and no translation was necessary (United States Census Bureau, 2014).

### **Educational Interventions**

Several studies discuss the importance of educational interventions for children, which improve both preventative knowledge (Beaujean et al., 2013; Daltroy et al., 2007; Malouin et al., 2003) and preventative behaviors (Beaujean et al., 2013; Daltroy, 2007; Hayes & Peisman, 2003; Phillips et al., 2001).

Knowledge of LD heightens perceived risk, and improves protective practices (Beaujean et al., 2013; Daltroy et al., 2007; Malouin et al., 2003). Malouin et al. (2003) conducted a randomized controlled clinical study involving an educational intervention, and follow-up questionnaire for evaluation, to determine whether targeted tick-related education in an endemic area could decrease tick bites. Results indicated proportions of desired questionnaire responses increased significantly in subjects who received tick related educational materials. The interventional group also evidenced an increase in preventative knowledge, attitude and behavior measures. In a study by Daltroy et al. (2007), 30, 164 participants took part in a randomized controlled trial, investigating an educational intervention. The experimental group (13,562), who received the educational intervention, were found to practice precautionary behaviors when there was a perception of LD as a serious illness, as well as high self-efficacy (self-confidence) that one could perform a tick check and recognize early symptoms of LD. Beaujean et al. (2013) conducted a cross-sectional study of 1,447 children, ages 9 to 13, in the Netherlands. The study investigates whether knowledge and perceived threat of a tick bite increased protective behaviors in children. Beaujean et al. (2013) found that knowing someone who had gotten ill after a tick bite, and being aware of tick bite consequences or perceived severity, was associated with a higher knowledge level. A higher knowledge level could assist with predicting specific tick-bite protective behavior (Beaujean et al., 2013).

The research evidence demonstrates that LD preventative behaviors are simple and inexpensive for individuals. Any increase in tick preventative behaviors, will reduce the likelihood of infection (Daltroy et al., 2007). As stated by Daltroy et al. (2007): “From a public health standpoint, this is important, as 100% adoption of all behaviors is not necessary to confer protection. Each behavior, although perhaps a nuisance or not practiced daily, is relatively easy



to perform, and has analogs in other common practices, such as the use of creams, repellents, and clothing for mosquito protection and sun protection.” (p. 539).

Preventative behaviors were also studied and discussed in Hayes & Piesman (2003). Hayes & Piesman (2003), presented a meta-analysis of randomized controlled clinical studies on prevention of LD, including: educational intervention, tick checks, vaccination, use of repellants, prophylactic treatment after a tick bite, deer culling, and use of acaricides. Fifty-nine references were reviewed for the meta-analysis. Results clearly indicate that educational intervention can increase the proportion of people who perform preventative measures of tick checks, use repellants, and decrease the risk of infection. Similar results were also noted in Beaujean et al. (2013), in a cross-sectional study of 1,447 children, ages 9 to 13, in the Netherlands. The study investigated whether knowledge and perceived threat of a tick bite increased protective behaviors in children. A questionnaire was completed by all of the children investigating their knowledge of LD and LD risks. Conclusions indicated that children who knew someone that had been ill due to a tick bite, and knew about LD, had a better appreciation for the need to do tick body checks. It was also concluded that: “The relationship between health education programs for children (and their parents) about ticks and their possible consequences and prevention of these deserves further study.” (Beaujean et al., 2013). Another interesting outcome of the study, was that the questionnaire determined that 78% of the children had not been previously educated on ticks at school (Beaujean et al., 2013). This indicates a need for programs that reach out to children at school, as they may not be educated through their community or healthcare provider.

It was noted by Phillips & Liang (2001), that young people are particularly at risk and health education should emphasize preventive behaviors less frequently practiced: using tick repellent, avoiding tick areas, and wearing protective clothing. Their study indicated younger

individuals practiced fewer preventive behaviors than older individuals. The practice of preventive behaviors was not associated with a history of LD, but it was associated with finding more than five ticks per year on themselves (Phillips et al., 2001).

Elevated rates of LD in children necessitate educational interventions to assist with prevention. LD impacts the economic, social and physical well-being of children and their families, indicating a much needed involvement of nurses to assist with prevention. The evidence to support pediatric educational interventions to prevent LD in children is significant. These educational interventions should be in the children's native language (Beaujean et al., 2013; Heller, 2010). To decrease the risk of LD diagnoses in children, educational interventions should include instruction for protective practices such as tick checks, wearing protective clothing, and use of repellants, as well as tick ecology education (Beaujean et al., 2013; Daltroy et al., 2007; Hamlen, 2009; Heller, 2010; Malouin et al., 2003; Nelder et al., 2014; Phillips, 2001; Vasquez et al., 2008; Wormser et al., 2006). Educational interventions will improve preventative knowledge (Beaujean et al., 2013; Daltroy et al., 2007; Malouin et al., 2003) and preventative behaviors (Beaujean et al., 2013; Daltroy et al., 2007; Hayes & Peisman, 2003; Phillips et al., 2001), and lead to improved use of personal protective practices.

### **Theoretical Frameworks**

The theoretical framework used for this educational intervention is the Health Belief Model (HBM) (Janz & Becker, 1984). The HBM asserts that perceived threat, which is a combination of perceived seriousness and susceptibility to a health condition, leads to a higher likelihood of using health-promoting behaviors (Janz & Becker, 1984). Therefore an educational program designed to raise awareness about the threat of LD, results in "cue to action" to prevent infection (Janz & Becker, 1984).

This DNP project was an educational intervention, delivered to children in their school setting, with the intention of promoting behaviors to help prevent Lyme disease (LD) in an endemic area of Massachusetts. Internal and external factors of the context dimension, are driving the elevated LD incidence rates in children aged five to nine years old (MDPH, 2014), and are due to reforestation after the abandonment of pastures and farms, increased development and recreational use of habitat, and expansion in the density of white tailed deer who are the reproductive host (Commonwealth of Massachusetts, 2013). The content dimension, or what needs to be transformed, are the practices of personal protection measures such as tick checks, use of protective clothing, and use of insect repellent (Commonwealth of Massachusetts, 2013). These practices have been studied in the scientific literature and have proven effective in decreasing LD risk. For the process dimension, the DNP project addressed the problem through in-person instruction, and an educational packet, with one section of the packet for children, and the other for their parents. The purpose of the educational instruction and packet was to influence the perceived susceptibility and severity of contracting the condition, and possible negative medical and clinical consequences. In more than one literature report, it is indicated that there is a need for LD education targeted at children and their parents (Beaujean et al., 2013), which includes recognition of symptoms (Heller et al., 2010). The packet can be updated, as new scientific based evidence is gathered.

The educational intervention and packet were projected to positively benefit the chosen population, and the LD preventative measures discussed were both feasible and efficacious, as based on supporting literature (Beaujean et al., 2013; Daltroy, 2007; Hamlen & Kilman, 2009; Hayes & Piesman, 2003; Nelder et al., 2014; Wormser et al., 2006). The educational

intervention also provided preventative measures for the chosen population, which were both cost-effective and convenient, and may serve to lessen perceived barriers.

### **Project Setting and Description**

The intervention took place in Dover, MA, located fifteen miles southwest of Boston. The majority of the town is wooded, the Charles River runs through the town, and there are several ponds, swamps, and wetland areas. According to the United States Census Bureau (USCB) there were 508 children age five to nine (USCB, 2014). Eighty-Nine percent of the population speaks English (USCB, 2014). Dover has experienced a high rate of Lyme disease, due in part to a favorable habitat and a high population of deer, which promotes the life cycle of the deer ticks that carry LD (Town of Dover, 2014). State biologists estimate Dover has 25 to 30 deer per square mile, and the goal for this area of Massachusetts is eight deer per square mile (Martinez, 2012). The Dover Board of Health, was contacted by the MA Department of Public Health many years ago due to the high rate of LD being reported in its residents (Bonzagni, 2014). At the time of the intervention, there was no LD prevention or educational intervention taking place in the town which was directed specifically towards children (Bonzagni, 2014) (Town of Dover, 2014).

The organization chosen for the educational intervention was a public elementary school in Dover, named Chickering Elementary School. Their Mission statement is as follows: “Chickering School is a place where children learn, laugh, grow, care, and make a difference.” (Chickering Elementary School, 2014). This elementary school houses Kindergarten through Fifth grade, ages five to eleven. It is the only elementary school in the town (Chickering Elementary School, 2014). As of the US Census Fact Finder (2014) and Chickering School (2014), there are 47 children in Kindergarten, 272 in grades one through four, and approximately

161 students in fifth grade. This totals approximately 480 students. There are presently three Kindergarten classes, four first grade classes, four second grade classes, five third grade classes, five fourth grade classes, and five fifth grade classes (Chickering Elementary School, 2014). Each class has one teacher and one assistant teacher (Chickering Elementary School, 2014). The school has two open fields, a playground, and is surrounded by thick woods.

The targeted sample, were Kindergarteners who attend the school, and their parents. The sample included approximately 47 Kindergarteners, who were separated into three classes. As the at risk population in MA started at the age of five (MDPH, 2014), Kindergarteners were the chosen sample for this educational intervention.

### **Design and Methods**

The purpose of the educational intervention was to prevent infection of LD by increasing knowledge of the disease, including measures to protect against it. Consistent with HBM, this was completed by educating children and parents about the seriousness of, and susceptibility to the health condition, in hopes of leading to an increase in health promoting behaviors (Janz & Becker, 1984).

The planned intervention had two parts. An educational packet for the children and parents on LD prevention (please see Appendices A through G), and educational sessions for the children. The educational intervention, which included the pre-test, education, and post-test, took place in March of 2015.

Prior to the presentation, the children in each classroom were asked five questions, with two possible answers provided by the DNP student, which could be chosen for the answer. For example, if the question “What does a deer tick look like?” was asked, the DNP student would hold up a picture of a deer tick and a picture of an ant for the children to choose from. The

number of responses for each answer was documented. This pre-test evaluated their knowledge on ticks, LD, and LD risks. Please see Table 2. below for the list of questions.

Table 2. Pre-test/post-test questions (Beaujean et al., 2013)

Question number	Abbreviated question	Images presented
1	What does a deer tick look like?	Deer tick, Ant
2	Where does a tick live?	Forest, Paved playground
3	What might happen after you are bit by a tick?	Child itching, Sick child
4	How can you prevent a tick bite?	Tick check sites, Child washing hands
5	Pre-test: Have you checked for ticks before? Post-test: Will you check for ticks in the future?	Never, Every time

The DNP student then taught all of the children in the classroom about LD for about twenty minutes, and completed a post-test with the same questions immediately after the instruction. The pre-test, educational intervention and post-test, were completed on the same day

in the chosen classrooms (there were three classrooms). After the post-test, the children were reminded to take the educational packet home, discuss what they learned with their parents, and show their parents the educational packet, which in part was targeted to adult learning. Some parents don't know about LD risks, and do not know about the symptoms and side effects (which can be severe). If risk is something the DNP student provided instruction on, including perceived severity, there may be the "cues to action" for both the parent and child, which the HBM discusses (Janz & Becker, 1984).

Kindergarten children cannot all read, so the packet section for the children was age appropriate, and showed a picture and actual size of a deer tick, pictures of where they could be found, a picture of a child with an attached tick reporting it to an adult, a picture of the bulls-eye bite sometimes seen after a bite, and pictures of protective clothing on a child. There were also simple words such as "tick" and "woods". Live teaching covered tick identification resources, tick reduction and avoidance strategies, and tick-bite management strategies. The children were be educated on the fact that Lyme disease can be contracted from the tick and make them ill, symptoms such as joint pain and rash were discussed. It was repeated several times to the children, that they need to tell a parent or another adult in the home or at school if they see a tick on themselves.

The parental section of the packet included more in-depth tick reduction and avoidance strategies, and tick removal and bite management strategies. There was also be an extensive list of symptoms and other risks due to LD, such hepatitis and cardiac problems (MGH, 2013), and a variety of neurological and psychiatric problems (The International Lyme and Associated Diseases Society, 2014).

To provide for sustainability of the LD prevention intervention, the DNP student worked closely with the school nurse who became proficient in the educational modules. Three different educational flyers, created by the DNP student, were provided to the school nurse for future and continued use (please see Appendices A, D, and E). The separate flyers included age appropriate information for five to eight year olds, 10 to 13 year olds, and adults. The flyers included pictures of ticks, information about where ticks can be found, symptoms of LD, and prevention strategies. The school has agreed that the educational sessions will continue on a yearly basis, and will be taught by the school nurses, with the DNP student available for consultation.

### **Evaluation of the Applied Intervention**

The type of evaluation that worked best for the program was the one-group time series. Following Issel's (2014) decision tree, it is possible to collect pre-test and post-test data both before and after the intervention. The population of children were the unit of analysis, with no comparison group, leading to the one-group time series. Issel (2014) discusses school interventions in relation to the one-group time series, and states it is useful for program evaluations in schools.

Previous to the group teaching, and based on LD educational methods exemplified by Beaujean et al. (2013), the children were asked five questions individually, evaluating their knowledge on ticks, LD, and LD risks (see Table 2). Pre and post-test answers from the children were grouped as "Correct" or "Incorrect". The children were then taught about LD in a group setting, and completed an individual post-test with the same questions. The comparison regarding the number of incorrect answers before, as opposed to after the educational intervention, determined if the children were more likely to be able to identify the health threat of LD, and have increased knowledge on how to practice preventative measures. This evaluation



was found to be effective by Cao, Chen and Wang (2014), who evaluated a health education program for children based on the HBM model, which was designed to prevent accidental injury.

Grouped answers were added to an excel spreadsheet to determine percentage of improvement, or measure of change. As completed by Beaujean et al. (2013), percentages between the pre and post-test LD educational intervention, determined the percentage of change. The goal was to evidence post-intervention improvement for all questions, with an overall improvement of 40% in correct answers. In addition, *t*-tests were completed for each classroom, with the goal of determining a statistically significant improvement in correct post-test answers.

### **Goals and Objectives**

The objective of the educational intervention was to increase preventative knowledge of LD in children and their parents. The comparison regarding the number of correct answers between the pre-test and the post-test, determined if the children were more likely to be able to identify risks of LD, and have increased knowledge on how to practice preventative measures. The goal was to see a 40% improvement in correct answers on the post-test.

New knowledge gained included whether or not children are more likely to be able to identify risks of LD, and have knowledge on how to practice preventative measures after an LD educational intervention. If it was found that the children do learn identification and prevention measures, it would be possible to replicate this intervention for other age groups, especially those up to the age of 9, who are at higher risk (MDPH, 2014). The long term goal for this type of intervention would be to have children and parents practice preventative measures, have a lower the rate of LD in Norfolk County, MA, and decrease the hundreds of school absences, and illness due to LD (MDPH, 2011).

### **Budget**

The DNP student had a home printer for printing handouts. Cost for supplies, including paper (approximately 200 pages) and colored printer ink for the packet, was approximately seventy-five dollars. Travel costs to the school which included gas, was approximately fifty dollars. Supplies and travel costs were paid for by the DNP student. Please see Table 3. below for a line item budget.

Table 3. Budget

Line Item	Cost
Paper	\$50.00
Colored Printer Toner	\$25.00
Travel costs: Gas	\$50.00
Total	\$100.00

### **Protection of Human Subjects**

This educational intervention was a quality improvement project and research translation (Dundon, 2014). The intervention used was based on previous research by Beaujean et al., which attempted to improve the quality of LD healthcare education the children received. A pre-test and post-test was used to evaluate the intervention, and posed no risk to the children. No personal identifiers were used. For the pre-test and post-test identification, a classroom number was used to identify the classroom. As a result of the above factors, there was no need for IRB approval.

It was not necessary for parental permission to be obtained via a written permission slip sent home with the children. The school principal approved the educational intervention, and gave permission to the DNP student to complete the educational intervention in the Kindergarten classrooms. The DNP student who completed this intervention, was certified in the state of MA to teach children ages Kindergarten through third grade, and kept the educational intervention age appropriate.

The educational intervention took place in March of 2015, and included the pre-test, educational session, and post-test. The evaluation of the intervention took place in April of 2015. As May, June and July are peak months for tick activity in the Northeast (Stafford, 2007), the intervention took place before a high risk LD season. For the project timeline chart please see Table 1. below.

Table 1. Project time line

Project Task	March 2015 Class 1, 2 & 3	April 2015
Pre-test	X	
Live educational intervention and presentation of LD packet	X	
Post-Test	X	
Evaluation of		X

Intervention		
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### **Data Analysis**

Pre-test and post-test data was collected and arranged in percentage tables to determine average percentage of improvement in correct answers. As completed by Beaujean et al. (2013), percentages between the pre and post-test LD educational intervention, will indicate the percentage of change. The first results table contains the number and percentages of correct answers for each pre-test question, the second table contains number and percentages of correct answers for each post-test question. The third table contains the average percentage of improvement in correct answers overall. In addition, *t*-tests were completed for each class, with the goal of determining a statistically significant improvement in correct post-test answers. Please see the Results section for tables 4. to 7.

## **Results**

### **Student Demographics**

The student sample was compromised of 48 Kindergarteners in three different classes. The students attended the one public school in Dover. The children were all between the ages of five to six years old. Male students compromised 58.3% of the sample, while females compromised 41.7% of the sample. In regards to racial demographics, 87.5% of the children were Caucasian, 8.3% were Asian, and 4.2% were Spanish.

### **Effect of Educational Intervention**

The purpose of the educational intervention, was to prevent infection of LD by increasing knowledge of the disease, including preventive measures, among young children and their

parents. The goal was to show post-intervention improvement for all questions, with an overall post-test improvement of 40% in correct answers.

The objective of the project, to increase preventative knowledge as indicated by post-intervention improvement for all questions, was met. The comparison in the number of correct answers, between the pre-test and the post-test, evidenced improvement from 10.6% to 54.2% for each post-test question (please see tables 4., 5. and 6.). Table 6. shows the change in responses pre and post-test by question. The goal of reaching an overall improvement of 40% in correct answers was achieved.

Table 4. Number and percentage of correct answers pre-test

	Class #1 (N=16)	Class #2 (N=17)	Class #3 (N= 15)
Question #1 Tick recognition	12 (75.0%)	17 (100%)	14 (93.3%)
Question #2 Tick habitat	13 (81.3%)	13 (76.5%)	12 (80.0%)
Question #3 Consequence of tick bite	8 (50%)	9 (52.9%)	11 (73.3%)
Question #4 Bite prevention	13 (81.3%)	9 (52.9%)	11 (73.3%)

Question #5	6 (37.5%)	7 (41.2%)	5 (33.3%)
Tick-check completion			

Table 5. Number and percentage of correct answers post-test

	Class #1 (N=16)	Class #2 (N=17)	Class #3 (N= 15)
Question #1	16 (100%)	17 (100%)	15 (100%)
Tick recognition			
Question #2	16 (100%)	16 (94.1%)	15 (100%)
Tick habitat			
Question #3	13 (81.3%)	13 (76.5%)	13 (86.6%)
Consequence of tick bite			
Question #4	14 (87.5%)	17 (100%)	15 (100%)
Bite prevention			
Question #5	16 (100%)	17 (100%)	15 (100%)
Tick-check completion			

Table 6. Average percentage of improvement in correct answers

	Class #1 (N=16)	Class #2 (N=17)	Class #3 (N= 15)	Average percentage of improvement in correct answers
Question #1  Tick recognition	25%	0%	6.7%	10.6%
Question #2  Tick habitat	18.7%	17.6%	20%	18.8%
Question #3  Consequence of tick bite	31.3%	17.6%	20%	22.%
Question #4  Bite prevention	6.2%	47.1%	26.7%	26.6%
Question #5  Tick-check completion	62.5%	58.8%	41.2%	54.2%

A paired *t*-test was used to determine if the null hypothesis; that there is no difference in the mean of the pre-test and post-test scores, should be rejected or accepted (please see Table 7. below).

Table 7. Mean difference, Standard deviation difference, and p-values for the three Kindergarten classes

Class number	Mean; Correct answers Pre- test	Mean; Correct answers Post- test	Mean difference between pre and post-test correct answers	Standard deviation difference	p-value
1	10.4	15	4.6	3.36	.01883
2	11	16	5.0	4.0	.0245
3	10.6	14.6	4.0	3.54	.05017
Mean p-value of all three classes					.03116

In classes number one (p-value = .01883) and two (p-value = .0245), the evidence suggests rejection of the null hypothesis using an alpha level of .05 (Issel, 2013). Thus indicating a statistically significant improvement in post-test scores (as measured by correct responses), after the educational intervention. Although class number three (p-value = .05017), shows an improvement in scores, the difference is not statistically significant. The mean p-value of the aggregate data of all three classes (p=.03116), indicates a statistically significant improvement in post-test scores after the educational intervention.

### Discussion

This LD educational intervention program was undertaken to address the public health problem of LD rates rising in children between the ages of five to nine (MDPH, 2014), and to



specifically assist with prevention in this age group, in a highly endemic town. During the educational interventions, which took place mid-day and in the children's classrooms, the children were well behaved and actively engaged. They were excited to have a guest speaker, and they were also eager to tell their stories regarding their experiences with ticks and LD. The children enthusiastically awaited knowing who had raised their hand for the correct answer after each pre-test question, and also seemed excited to raise their hand to indicate answers during the post-test.

The time allotted to the DNP student by the school (40 minutes for each class intervention), was enough to allow for a question and answer period after each educational session. During this question and answer period, the children asked appropriate and intelligent questions regarding topics such as tick removal, tick habitat and tick behavior, all of which the DNP student answered in an age appropriate manner for children ages 5 to 6. In addition, several children in each class reported either having been diagnosed with LD, or having a family member diagnosed with LD. The teachers, two in each class, were supportive and positive throughout the educational intervention, and had several questions about LD. The teachers responded positively to the educational LD packets that each child took home to the parents.

The theoretical framework used for this educational intervention was the Health Belief Model (HBM) (Janz & Becker, 1984). The HBM model, was a positive framework for an educational intervention to improve preventative knowledge in school aged children. The HBM asserts that perceived threat, which is a combination of perceived seriousness and susceptibility to a health condition, leads to a higher likelihood of using health-promoting behaviors (Janz & Becker, 1984). Consistent with HBM, education on the threat of LD (feeling sick, fever, rash, headache, joint pain), as well as the susceptibility and the seriousness of the disease, was

explained during the educational sessions, and provided in the LD packets for the parents. For the children, this led to an increase in knowledge of health promoting behaviors (Janz & Becker, 1984), as evidenced by the percentage of improvement in post-test correct scores, and the significant difference in scores. The evaluation of the LD educational intervention, demonstrated its effectiveness in increasing children's likelihood to identify the health threat of LD, and have increased knowledge on how to practice preventative measures. These evaluation results are similar to findings by Cao, Chen and Wang (2014), who evaluated a health education program for children based on the HBM model.

As previously stated, the purpose of the educational intervention was to prevent infection of LD by increasing knowledge of the disease, including measures to protect against it. As mentioned in the literature, knowledge of LD heightens perceived risk, and improves protective practices (Beaujean et al., 2013; Daltroy et al., 2007; Malouin et al., 2003). The educational intervention was designed to raise awareness about the threat of LD, resulting in the "cue[s] to action" of the HBM model, in order to prevent infection (Janz & Becker, 1984). A preventative cue to action was highly evidenced for the tick-check/prevention question (number five), when the difference of improvement for the correct answer between the pre-test and post-test indicated an improvement of 54.2%. The additional four questions during the post-test, also evidenced improvement in correct answers, therefore indicating increased knowledge of the disease in regards to tick recognition, consequences of a tick bite and bite prevention. In addition, as stated by in the practice guidelines by the IDSA (Wormser et al., 2006), and supported by the literature, the best currently available method for preventing tick-transmitted infections, is avoidance of tick-infested areas. The IDSA recommended that this be taught to children to enhance pre-cautionary behavior (Phillips et al. 2001; Wormser et al., 2006). Question number two, which

involved tick habitat (the children were taught to avoid the habitat) evidenced an 18.8% improvement in correct post-test answers.

According to the COM (2013), education should include tick identification resources, tick reduction and avoidance strategies, and tick-bite management strategies, all of which were included in the educational session and the LD packet. The intervention was based on evidence from previous studies indicating that educational intervention for LD should include tick checks, wearing protective clothing, use of repellants, the risk of LD infection, and recognition of symptoms (Beaujean et al., 2013; Hayes & Piesman, 2003; Heller et al., 2010; ISDA, 2013; Malouin et al., 2003; Vasquez et al., 2008). This information was discussed during the educational sessions and included in the parent LD packet, thus impacting perceived benefits of completing the preventative interventions.

Children who were not presently doing tick-checks, or whose parents' were not doing tick checks (54.2 %), all indicated they would start doing tick checks after being outside. A strong message to the children included "telling an adult" when they saw a tick on themselves, in hopes of preventing future cases of LD in this at risk population. The children were observed repeatedly saying they would "tell an adult" if they were to find a tick on themselves.

New knowledge gained from this intervention, included that the children were more likely to be able to identify risks of LD, and have knowledge on how to practice preventative measures after an LD educational intervention. As it was found that the children do learn identification and prevention measures after an educational intervention, it would be possible to replicate this intervention for other age groups, especially those up to the age of 9, who are at higher risk (MDPH, 2014). The long term goal for this type intervention would be to replicate

the educational intervention in other local endemic towns, and to lower rates of LD in Norfolk County, MA, decreasing the hundreds of school absences, and illness due to LD (MDPH, 2011).

The evaluation of this educational program assisted in discovering the positive effect of the educational intervention on the LD knowledge of children, and may provide as a basis for future LD educational programs in this population. Recommendations for the future in this highly endemic area, include the continuation of school-based LD educational interventions, as well as the dissemination of LD information to local parents. In the Beaujean et al. (2013) study, 78% of children reported not being previously educated on ticks in school, while this population was 100% previously uneducated on ticks at the school. Elevated rates of pediatric LD in this endemic town, paired with the lack of educational interventions in the school, necessitates future educational interventions to assist with prevention.

LD impacts the economic, social and physical well-being of children and their families, indicating a much needed involvement of nurses to assist with prevention. The evidence to support pediatric educational interventions to prevent LD in children is significant. To decrease the risk of LD diagnoses in children, educational interventions should include instruction for protective practices such as tick checks, wearing protective clothing, and use of repellants, as well as tick ecology education (Beaujean et al., 2013; Daltroy et al., 2007; Hamlen, 2009; Heller, 2010; Malouin et al., 2003; Nelder et al., 2014; Phillips, 2001; Vasquez et al., 2008; Wormser et al., 2006). Educational interventions will improve preventative knowledge (Beaujean et al., 2013; Daltroy et al., 2007; Malouin et al., 2003) and preventative behaviors (Beaujean et al., 2013; Daltroy et al., 2007; Hayes & Peisman, 2003; Phillips et al., 2001), and lead to improved use of personal protective practices. Available research, demonstrates that LD preventative behaviors are simple and inexpensive for individuals. Any increase in tick preventative

behaviors, will reduce the likelihood of infection (Daltroy et al., 2007). As stated by Daltroy et al. (2007): “From a public health standpoint, this is important, as 100% adoption of all behaviors is not necessary to confer protection. Each behavior, although perhaps a nuisance or not practiced daily, is relatively easy to perform, and has analogs in other common practices, such as the use of creams, repellents, and clothing for mosquito protection and sun protection.”.

Continued education on LD in this endemic town is important as many parents may be geographically new to the area, and there may be little understanding of the symptoms and dangers of LD. This continuing program of education is necessary as indicated by the children’s report in the pre-test that 54.2% of them do not have tick checks completed at home. Replication of this intervention for other age groups, especially those up to the age of 9, who are at higher risk (MDPH, 2014), is also recommended. Additional educational support should be provided to school nurses, and pre-school teachers who do not have access to a school nurse. This future educational support has been offered to the Dover Board of Health Lyme Disease Committee, and to the local school system, by the DNP student.

As stated by (Beaujean et al., 2013): “The relationship between health education programs for children (and their parents) about ticks and their possible consequences and prevention of these deserves further study.”. It should be noted that although there were literature reports regarding pediatric LD education that were discovered during the literature search for this intervention, the number of LD literature reports regarding LD education and the pediatric population were limited. In the future, additional research on successful pediatric LD educational prevention, is in need of publication in nursing and scientific journals.

## **Conclusion**

The results of this educational intervention for Kindergarteners indicate that instruction regarding tick ecology and protective practices, increased preventative knowledge of LD in children as young as five. Children were able to identify the deer tick, discuss where ticks live, understood a tick bite could make them sick, and prevention techniques such as tick checks. Class number three trended toward a non-statistically significant improvement in correct post-test. This could be due in part to data noted by Beaujean et al. (2013), which indicated children who have known a person who became ill after tick-bite, were associated with a good perceived severity and LD knowledge score. Beaujean et al. (2013) also found that knowing someone who had gotten ill after a tick bite, and being aware of tick bite consequences or perceived severity, was associated with a higher knowledge level. A higher knowledge level could assist with predicting specific tick-bite protective behavior (Beaujean et al., 2013). The DNP student witnessed many children speaking about LD diagnoses in themselves or family members. It is possible that the children in class number three had knowledge of people with previous tick bites and LD, therefore evidencing a slight trend towards statistical non-significance.

The LD educational intervention Capstone project was effective in increasing preventative knowledge of LD in children. Increasing preventative knowledge is essential for this endemic community, to keep the local children safe from what can be a devastating tick-borne illness. The project was successfully completed by translating evidence from a Norwegian LD prevention study, and the project demonstrates that LD education can improve LD prevention knowledge in a young and at risk age group.

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AGES 5 - 9

This is a deer tick, and one bite can make you sick.



Ticks live in the forest and grasses where you play.



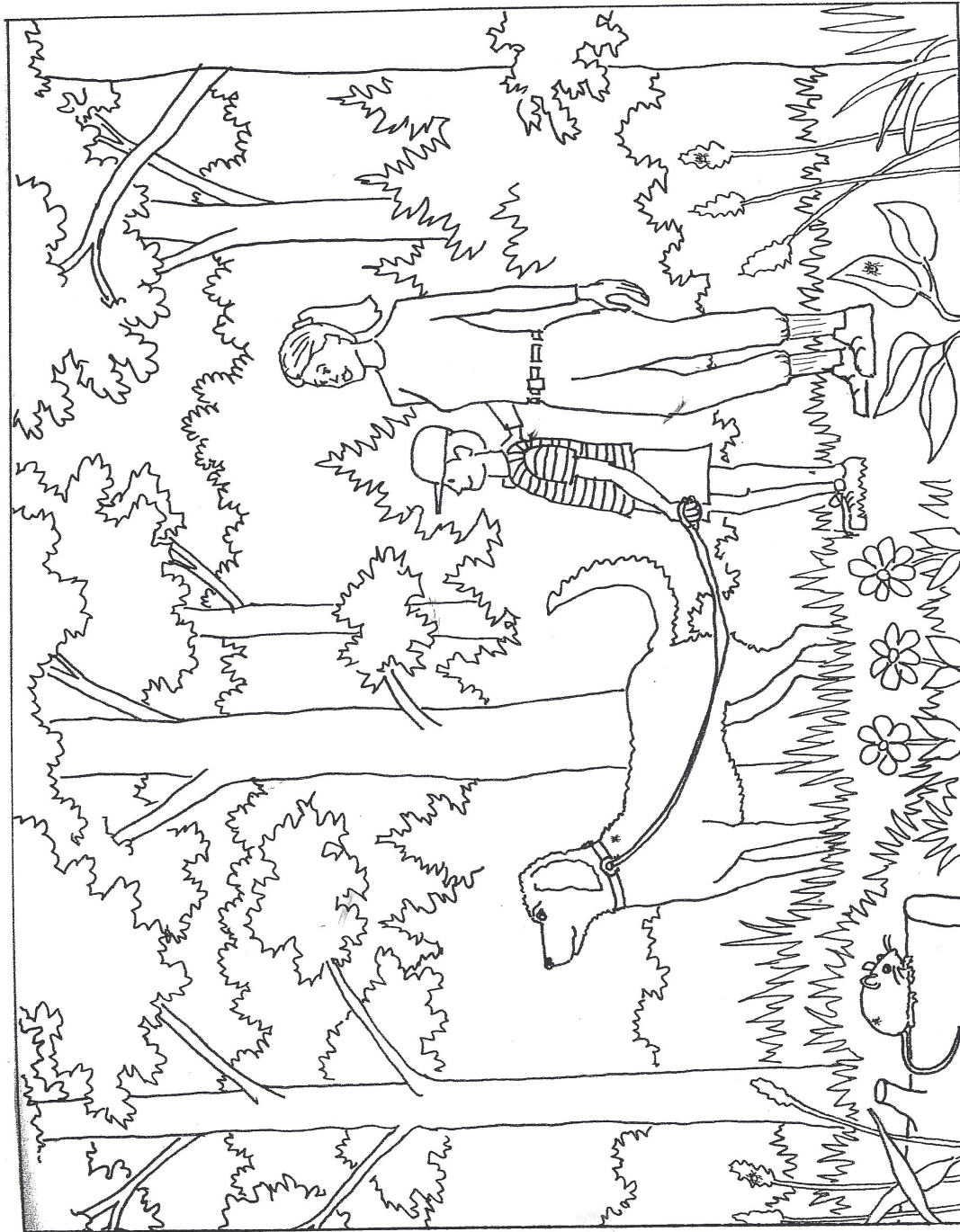
### PREVENTION



Daily tick check.

Wear bug spray

If you find a tick, tell an adult.



Appendix C. Child handout ages five to nine (Lyme Research Alliance, 2006).

NA: \_\_\_\_\_

DATE: \_\_\_\_\_

## OBJECTIVE 1

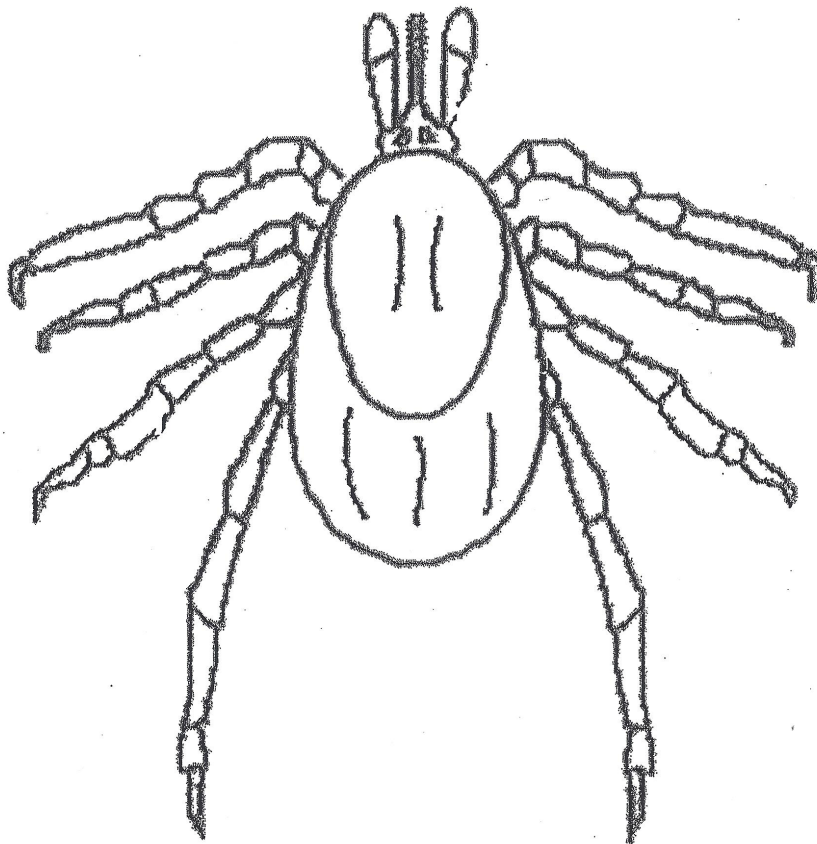
# The Female Deer Tick

Color in the deer tick below.

Which part of the tick is black?

Which part of the tick is reddish-brown?

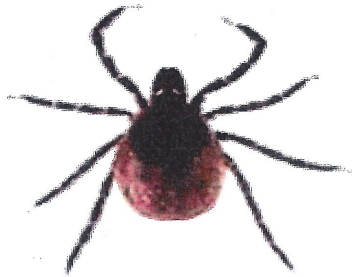
Hint: Look at page 5 for tick colors.



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KINDERGARTEN

AGES 10 - 13



### DISEASES FROM TICKS

The deer tick can carry many diseases, one is called Lyme disease.

Ticks can be very, very small. Can you see the one in the picture on the right?

Ticks are found on the ground, in long grass and forests.

### HOW YOU MIGHT FEEL AFTER YOU ARE BITTEN

*If you are bitten by a tick, and you get sick, you might feel like this....*

Stiff, chilly, fever, headaches, tired, with sore legs, arms, elbows and knees.

Some people get a rash.

### HOW TO KEEP TICKS AWAY

Every day you must check your body for ticks (pets too!).

Bug spray with DEET.

Wear long clothing so the ticks cannot get to your skin.

Wear light colors so you can see a tick on you.

TELL AN ADULT IF YOU FIND A TICK ON YOU.

THE ADULT WILL HELP YOU REMOVE IT.



ADULT



### TICK BORNE DISEASE STATISTICS

The deer tick can carry Lyme disease, Babesiosis and Anaplasmosis.

Nymph stage deer ticks: **About 1 in 4 carry Lyme disease.**

Adult stage deer ticks : **About 1 in 2 carry Lyme disease.**

Ticks are found at ground level and in long grass. Ticks don't fly and they don't jump.

**Rates have been rising in children ages 5-9, and the elderly.**

### SYMPTOMS AND RISKS

#### Early stage

Flu-like symptoms (stiff neck, chills, fever, swollen lymph nodes, headaches, fatigue, muscle aches, and joint pain)

Skin rash (Only 68% get the bulls-eye rash!)

#### Late Stage

Neurological effects: poor motor coordination, seizures

Hepatitis and Cardiac issues

Psychological/behavioral problems, learning disabilities

### PREVENTION

**Daily tick checks (pets too!)**

**Permethrin Spray applied to clothing and shoes (not skin).**

**DEET repellent for the skin.**

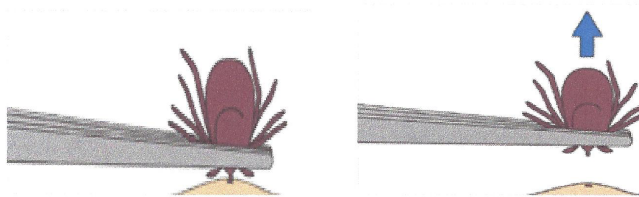
**Wear protective clothing – long sleeves, pants, socks, regular shoes (not flip flops or crocks). Tuck pants into socks. Light colored clothing will enable you to see the ticks more easily.**



ADULT

**TICK REMOVAL and TESTING**

- Using pointy tweezers, grasp tick by the head and pull straight up. Avoid twisting
- DO NOT USE: matches, cigarettes, petroleum jelly, gasoline, nail polish remover, etc.
- After removing tick, apply antiseptic to bite area.
- Note date when tick was removed.
- Save tick for identification

**TESTING**

Tick testing can be completed for a fee, see [www.tickdiseases.org](http://www.tickdiseases.org)

Through the Community Innovation Challenge Grant, ticks from 32 Massachusetts towns (including those in Barnstable County) may qualify for free testing through UMASS Amherst's Laboratory of Medical Zoology, see [www.TickReport.com](http://www.TickReport.com)

Appendix F. Adult handout (Massachusetts Department of Public Health, 2011).

<h1>PUBLIC HEALTH FACT SHEET</h1>	<h1>Lyme Disease</h1>
<p>Massachusetts Department of Public Health, 305 South Street, Jamaica Plain, MA 02130</p>	
<p><b>What is Lyme disease?</b></p> <p>Lyme disease is caused by bacteria (germs) that are spread by tiny, infected deer ticks. Both people and animals can have Lyme disease.</p> <p><b>Where do cases of Lyme disease occur?</b></p> <p>In the United States, Lyme disease most commonly occurs in the Northeast and mid-Atlantic regions and in the upper Midwest. In Massachusetts, Lyme disease occurs throughout the state.</p> <p><b>How is Lyme disease spread?</b></p> <p>Lyme disease is spread by the bite of an infected deer tick. The tick usually must be attached to a person for at least 24 hours before it can spread the germ. Deer ticks in Massachusetts can also carry the germs that cause babesiosis and human granulocytic anaplasmosis (also known as human granulocytic ehrlichiosis). Deer ticks are capable of spreading more than one type of germ in a single bite.</p> <p><b>When can I get Lyme disease?</b></p> <p>Lyme disease can occur during any time of the year. The bacteria that cause Lyme disease are spread by infected deer ticks. Young ticks (nymphs) are most active during the warm weather months between May and July. Adult ticks are most active during the fall and spring but may also be out searching for a host any time that winter temperatures are above freezing.</p> <p><b>How soon do symptoms of Lyme disease appear after a tick bite?</b></p> <p>Symptoms of early Lyme disease, described below, usually begin to appear from 3 to 30 days after being bitten by an infected tick. If untreated, symptoms of late Lyme disease may occur from weeks to years after the initial infection.</p> <p><b>What are the symptoms of Lyme disease?</b></p> <p><b>Early stage (days to weeks):</b> The most common early symptom is a rash (erythema migrans) where the tick was attached. It often, but not always, starts as a small red area that spreads outward, clearing up in the center so it looks like a donut. Flu-like symptoms, such as fever, headache, stiff neck, sore and aching muscles and joints, fatigue and swollen glands may also occur.</p> <p>Even though these symptoms may go away by themselves, without medical treatment, some people will get the rash again in other places on their bodies, and many will experience more serious problems. <i>Treatment during the early stage prevents later, more serious problems.</i></p> <p><b>Later stages (weeks to years):</b> If untreated, people with Lyme disease can develop late-stage symptoms even if they never had a rash. The joints, nervous system and heart are most commonly affected.</p> <ul style="list-style-type: none"> <li>• About 60% of people with untreated Lyme disease get arthritis in their knees, elbows and/or wrists. The arthritis can move from joint to joint and become chronic.</li> <li>• Many people who don't get treatment develop nervous system problems. These problems include meningitis (an inflammation of the membranes covering the brain and spinal cord), facial weakness (Bell's palsy) or other problems with nerves of the head, and weakness or pain (or both) in the hands, arms, feet and/or legs. These symptoms can last for months, often shifting between mild and severe.</li> <li>• The heart also can be affected in Lyme disease, with slowing down of the heart rate and fainting. The effect on the heart can be early or late.</li> </ul>	

### Is there treatment for Lyme disease?

People who are diagnosed with Lyme disease can be treated with antibiotics. Prompt treatment during the early stage of the disease prevents later, more serious problems.

### What can I do to lower my chances of getting Lyme disease, or any other disease, from ticks?

**Prevention begins with you!** Take steps to reduce your chances of being bitten by any tick. Ticks are most active during warm weather, generally late spring through fall. However, ticks can be out any time that temperatures are above freezing. Ticks cling to vegetation and are most numerous in brushy, wooded or grassy habitats. They are not found on open, sandy beaches, but may be found in grassy dune areas. When you are outside in an area likely to have ticks (e.g. brushy, wooded or grassy places), follow these simple steps to protect yourself and your loved ones:

- Use a repellent with **DEET** (the chemical N-N-diethyl-meta-toluamide) or **permethrin** according to the instructions given on the product label. DEET products should not be used on infants under two months of age and should be used in concentrations of 30% or less on older children. Permethrin products are intended for use on items such as clothing, shoes, bed nets and camping gear, and should not be applied to skin.
- Wear long, light-colored pants tucked into your socks or boots, and a long-sleeved shirt. This may be difficult to do when the weather is hot, but it will help keep ticks away from your skin and help you spot a tick on your clothing faster.
- Stay on cleared trails when walking or hiking, avoiding the edge habitat where ticks are likely to be.
- Talk to your veterinarian about tick control options (tick collars, repellents) for your pets.
- More information on choosing a repellent and how to use repellents safely is included in the MDPH Tick Repellents fact sheet at [www.mass.gov/dph/tick](http://www.mass.gov/dph/tick). If you can't go online, contact the MDPH at (617) 983-6800 for a hard copy.

#### *Did you know?*

You don't have to be a hiker on Cape Cod to worry about ticks. In Massachusetts, you may be bitten in your own backyard. There are lots of things you can do around your own backyard to make it less inviting for ticks! Visit the MDPH Tickborne Disease Website at [www.mass.gov/dph/tick](http://www.mass.gov/dph/tick) for suggestions.



#### **After spending time in an area likely to have ticks, check yourself, your children and pets for ticks.**

Young ticks, called nymphs, are the size of a poppy seed. Adult deer ticks are the size of a sesame seed. Both nymph and adult deer ticks can spread the bacteria that cause Lyme disease; however, nymphs are of more concern. They are aggressive feeders and so tiny that it can be difficult to see them on the body, unless you are looking carefully. When doing a tick check, remember that ticks like places that are warm and moist. Always check the back of the knees, armpits, groin, scalp, back of the neck and behind the ears. If you find a tick attached to your body, remove it as soon as possible using a fine-point tweezers. Do not squeeze or twist the tick's body, but grasp it close to your skin and pull straight out with steady pressure.

**Know the symptoms of Lyme disease** as described in this fact sheet. If you have been someplace likely to have ticks and you develop symptoms of Lyme disease, or any other disease carried by ticks, see your health care provider right away.

### Where can I get more information?

- Your doctor, nurse, or health care clinic or your local board of health (listed in the telephone directory under local government)
- The Massachusetts Department of Public Health (MDPH), Division of Epidemiology and Immunization at (617) 983-6800 or toll-free at (888) 658-2850, or on the MDPH Tickborne Diseases website at [www.mass.gov/dph/tick](http://www.mass.gov/dph/tick)
- Health effects of pesticides, MDPH, Center for Environmental Health at 617-624-5757

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Appendix G. Bookmark included in LD educational packet (Center for Disease Control, 2015)

## Prevent Lyme Disease

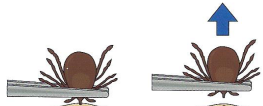


- Wear repellent
- Check for ticks daily
- Shower soon after being outdoors
- Call your doctor if you get a fever or rash

[www.cdc.gov/Lyme](http://www.cdc.gov/Lyme)



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## how to remove a tick

1. Use fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
2. Pull upward with steady, even pressure to remove the tick. Avoid twisting or jerking.
3. Clean the bite area and your hands with rubbing alcohol, iodine scrub, or soap and water.

### Notes:

- Remove the tick as soon as possible.
- If tick mouthparts remain in the skin, leave them alone. In most cases, they will fall out in a few days.
- Don't use nail polish, petroleum jelly, or a hot match to make the tick detach.
- If you develop a rash or fever within several weeks of removing a tick, see your doctor. Be sure to tell the doctor about your recent tick bite, when the bite occurred, and where you most likely acquired the tick.